A COMPARATIVE STUDY OF DRIVERS RENEWABLE ENERGY INITIATIVES ON SUSTAINABLE BUSINESS PERFORMANCE: A MEDIATING EFFECT OF ECO-EFFICIENT BASED GREEN SUPPLY CHAIN MANAGEMENT

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Abstrak

Isu pemanasan global telah menjadi perhatian utama setiap negara terutamanya di dalam industri elektrik dan elektronik dimana pergantungan kepada bahan api fosil telah berubah kearah sumber tenaga yang boleh diperbaharui. Perlaksanaan aktiviti dan projek tenaga boleh diperbaharui ini memerlukan jangka masa yang panjang. Hal ini menyebabkan cabaran dan tekanan diberikan untuk mendorong perlaksanaan pengurusan alam sekitar bagi meningkatkan prestasi perniagaan yang mampan. Kajian ini merupakan perbandingan antara negara Jerman dan Malaysia dengan mengemukakan model pembolehubah tenaga boleh diperbaharui (penglibatan kerajaan, sokongan organisasi dan teknologi) sebagai *antecedent* manakala pengurusan rangkaian bekalan eko-cekap (sistem maklumat hijau, pembelian hijau, eko-rekabentuk dan pembalikan logistik) sebagai pembolehubah pengantara (*mediator*). Hasil kajian adalah prestasi perniagaan yang mampan dari segi prestasi alam sekitar, operasi dan ekonomi.

Satu kaji selidik dalam talian telah diedarkan kepada industri elektrik dan elektronik dimana 110 data dari Jerman dan 140 data dari Malaysia telah dianalisa menggunakan SmartPLS 2.0 dan IBM SPSS 22. Analisa menunjukkan German terlebih dahulu mengamalkan dasar hijau berbanding Malaysia. Selain itu, Malaysia memerlukan sokongan dan perlaksanaan polisi dari kerajaan untuk membantu industri pembuatan berdaya mampan. Teori yang digunapakai kajian ini adalah teori institusi dan sumber asli berasaskan pandangan. Kajian ini juga telah mengemukakan cadangan bagi perlaksanaan inisiatif tenaga boleh diperbaharui bagi pengamal industri beserta beberapa batasan kajian dan cadangan bagi penyelidikan masa hadapan.

Abstract

Global warming become major concern in every country especially electrical and electronic industry in order to be less dependency on fossil fuels and more towards renewable energy sources. However, implementation of renewable energy projects and activities have been slow to materialize. Therefore, these challenges and pressures push industry to implement environmental management practices in order to achieve sustainable business performance. This study is a cross-national study among Germany and Malaysia with a model for drivers of renewable energy initiatives (i.e. government involvement, organizational support and technology support) on the antecedents, eco-efficient based green supply chain management (i.e. green information system, green purchasing, eco-design and reverse logistics) on mediator and outcomes are sustainable business performance in term of environmental, operational and economic performance.

An online survey is administrated to electrical and electronic industry in Germany and Malaysia respectively. 110 data from Germany and 140 data from Malaysia were analyzed using the SmartPLS 2.0 for structural equation modeling and IBM SPSS 22. Analytical results demonstrated that Germany has been earlier implemented policy than Malaysia. Besides that, Malaysia manufacturing awareness still not there so government has to implement and developed more policy to support manufacturing. The guiding theories in this study are institutional theory and natural resources based view. This study provides practical suggestions to practitioners on the drivers of renewable energy initiatives to implement eco-efficient based green supply chain management. However, there are few limitations in this study. This study ends with recommendations for future study.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter introduces the research outline of the study. It begins with the background of the study followed by a discussion of the problem statements, research objectives, and research questions. This chapter ends with a discussion of the study and gives a brief overview of the remaining chapters in the thesis.

1.2 Background of study

Today, global warming and climate change have become major concerns of humanity, and human activities that release a large amount of carbon dioxide (CO2) and other greenhouse gases into the atmosphere that are main contributors to global warming (Zhang et al., 2012). In Malaysia, a major contributor to the problem is the Electric and Electronic industry (E&E), which has become a major player in the country's manufacturing sector. Recognizing the need to go green, the government has developed initiatives including the launch of several different programmes to push Renewable Energy (RE) into the country's energy mix (Hashim & Ho, 2011).

Consequently, these challenges and pressures push firms to seriously consider not only environmental impacts (Zailani et al., 2012) but also operational and economic impacts. However, rapidly increasing awareness in industry that today's renewable energy supply chains are flawed has led to an understand that barriers to utilization of RE exist. Thus, researchers and practitioners in the field of supply chain management (Ramli & Munisamy, 2015) have begun looking at eco-efficiency as an approach to solving the

problem. One realization has been that a need exists to integrate eco-efficiency in green supply chain management in order to provide an adequate balance among environmental performance, operational performance and economic performance (Govindan et al., 2014).

In global business-to-business markets, shared resources between buyers and suppliers often result in competitive advantages and enhanced relationships between firms. Also changes in technology and globalization of products and services have resulted in more dynamic markets and greater uncertainty in customer demand (Cheung, Myers, & Mentzer, 2010). RE has become a focal construct in the E&E industry because RE has become a driving force in the effort to sustain the earth's natural resources and to improve quality of life. RE sources such as wind or solar energy off many advantages because they do not produce negative impacts like the emissions of hazardous substances such as greenhouse gases.

Across the globe, RE has become increasingly important for the economics of many countries (UNEP, SEFI, & NEF, 2009). According to the U.S. Energy Information's (2014) country analysis, Malaysia is the second largest user of non-renewable energy resources in the world, petroleum and other liquids, natural gas, and coal are the main primary energy sources consumed in Malaysia, with estimated shares of 40%, 36%, and 17% of consumption respectively in 2012. Only 3% come from hydroelectricity and 4% from biomass and waste. That is because the implementation of renewable energy projects and activities have been slow to materialize (Hashim & Ho, 2011). The lack of these projects may adversely impact the Malaysian economy in the future

From the perspective of eco-efficient green supply chain management and drivers of renewable energy initiatives, the E&E industry affects the environment, economy and

consumers across the country, and, because Malaysia exports many E&E products, across the world as well. For instance, the industry implement ISO 14001 which show that industry have a systematic process and strategic plan to ensure the quality of the product while, covers various aspect of environmental management thus the products are allowed to export to other countries (To & Lee, 2014).

To put the issue of energy in perspective, a cross-national comparison study between Germany and Malaysia was chosen as part of the exchange for the Masters of Business Administration (International Business) at Universiti Sains Malaysia (USM) and Technische Hochschulle Nuremberg Georg Simon OHM, Germany. By comparing these two countries, the impact of eco-efficient-based green supply chain management on business performance from the perspective of renewable energy initiatives in E&E industry between Germany (developed country) and Malaysia (developing country) can be measured.

To compare the two countries several metrics may be used. Both Germany and Malaysia have 13 states; the capital of Germany is Berlin, and the capital of Malaysia is Kuala Lumpur. Germany is bigger area wise than Malaysia, which have 357,002 square kilometres and 329,847 square kilometres of land mass respectively. The population in Germany was 80,996,685 and the population in Malaysia was 30,073,353 in 2014. The average household income in Germany is about twice that of Malaysia. Electricity production and electricity consumption in Germany is five times more than Malaysia in 2012 (CIA, 2015). However, Germany receives much less of its electricity from fossil fuels and much more of its electricity from renewal sources than does Malaysia (See Table 1.1 below).

Table 1.1

Measurement metrics Germany and Malaysia

Metric	Germany	Malaysia
Area	357,003 sq. kilometres	329,847 sq. kilometres
Population	80,996,685	30,073,353
GDP per capita in PPP	44,700 USD	24,500 USD
GDP composition	Services 68.4%, industry 30.8%, agriculture 0.9%	Services 56%, industry 34.7%, and agriculture 9.3%
Electricity consumption	582.5 billion kWh	112 billion kWh
Electricity from fossil fuels	51.1%	89.4%
Electricity from nuclear fuels	7.0%	0.0%
Electricity from hydroelectric plants	6.0%	10.6%
Electricity from renewal sources	35.0%	0.0%

Source: CIA, The World Factbook (2015)

Both governments have developed to reduce CO^2 emissions in the future. The German federal government has presented an energy strategy that aims to reduce CO^2 emissions by 40% from 1990 levels by 2020, 55% by 2030 and 80-95% by 2050 (Gullberg et al., 2014). Climate change goals together with energy security and competiveness concerns are the major reasons behind Germany's push to further expand renewable electricity and improve energy efficiency. While boasting major players in automobile manufacturing, machinery, precision equipment, heavy automotive, technology and software, Germany's E&E industry also plays an important part in Germany's industrial landscape (Economy, 2013; Julien & Lamla, 2011). According to ZVEI: Die Electroindustrie (2014), the German electronic sector plays an important role in the global

economy, with exports valued at 14.6 billion euros in 2014, exceeding the previous year's total by 9.8% (BBC, 2014).

Malaysia too has looked at its energy polices and the place that the E&E industry plays in it. The Malaysian government has been developing key policies and strategies for more than 30 years to achieve the nation's policy objectives, which are designed to mitigate the issues of security, energy efficiency and environmental impact to meet the rising energy demand (Occupational Structure The Green Technology Industry, 2011). Malaysia is also developing policies for RE to create alternative business models, renewable initiatives and more efficient technologies to reduce dependency on fossil fuels and mitigate the effects of climate change (Hashim & Ho, 2011; Mustapa et al., 2010).

Government of Malaysia has developed a long term goals to spearhead the sustainable development of renewable energy which increase generation of renewable energy power capacity to 2080MW (11%) by 2020, 4000MV (17%) by 2030 and 21.4 GW (73%) by 2050 (APEC, 2014).For instance, the Fifth Fuel of Small Renewable Energy Power Programme (SREP) was launched in 2001 with the aim of promoting a wider use of the huge amount of RE resources available in Malaysia, particularly biomass. Under this SREP Programme, industries should contribute to the generation and use of renewable energy by utilising of all types of RE sources including biomass, biogas, municipal wastes, solar, mini-hydro and wind (Tenaga, 2013). The Electrical and Electronics (E&E) industry is a critical element of Malaysia's long-term economic growth strategy, particularly within the three major ecosystems of semiconductor, solar and light emitting diode (LED) technologies.

As a developed country, Germany has been a forerunner in deploying RE sources and has ambitious goals for the future (Blazejczak et al., 2014). Germany began replacing both fossil and nuclear fuels with renewables 20 years ago (Scholz et al., 2014). The federal government implemented a programme called *Energiewende* (energy change/switch) for energy transition to a nuclear free and a low-carbon energy supply to maintain a competitive economy while shifting the energy structure from a heavy dependence on fossil fuels and nuclear energy to a system based primarily on renewable energies. However, achieving this goal has been a herculean task requiring thorough cooperation with European neighbours (Gullberg et al., 2014). Infrastructural and technological bottlenecks have also affected the programme's implementation, creating challenges in manufacturing, installations and maintenance (Scholz et al., 2014).

The results of government energy policy in Germany are subject to some controversy. According to (Frondel et al., 2010), government policy in German has resulted in massive expenditures showing little long-term promise for stimulating the economy, protecting the environment, or increasing energy security. Hillebrand et al. (2006) concluded that RES sources promotion would have a net positive employment impact in the short run due to RE source installations, which would turn negative over time due to the long-term costs of the feed-in tariff, which guarantees fixed tariffs for 20 years. Moreover, the German government has limited the feed-in-tariff for the solar industry; hence, this policy might affect the operational performance in the electrical and electronics sector (Abdmouleh et al., 2015). The impact of such confusion can be seen in that many Germany electronics companies have not taken full advantage of benefits of the capabilities as suggested in GSCM. The companies need to understand precisely GSCM

implementation in RE that benefits their business performance. E&E companies should implement GCSM to overcome the issues.

In Malaysian, the government has developed key policies and strategies for more than 30 years to achieve the nation's policy objectives, which are designed to address the issues of security, energy efficiency and environmental impacts to meet the rising energy demands. However, despite government efforts and growing public awareness of environmental issues, environmental problems continue to persist (Eltayeb et al., 2011). This is because renewable energy project and activities implemented by industry have been slow to materialize (Hashim & Ho, 2011). Despite the fact that government has encouraged industry to participate actively in making a low carbon economy become reality, the application level of these kinds of technologies remains in its infancy (Osman, Udin, & Salleh, 2012). One main constraint is the high cost of energy generation. Such institutional barriers present challenges that the industry must overcome. To date, concerns about the environmental outcomes for organizations remain open for debate and without a conclusion.

With the emphasis on sustainable development, renewable energy (RE) has become an area of concern in many countries because RE represents economically and environmentally sound energy growth. Typically, government provides the motivations for renewable energy developments through regulation or incentives (Tang, Chiara, & Taylor, 2012). Nonetheless, government requires the cooperation of the private sector in exploiting renewable energy as a suitable driver for industry (Aslani, Naaranoja, & Zakeri, 2012). The Electrical and Electronics (E&E) industry often is involved on renewable energy initiatives by providing various experts, implementing instructional projects and providing training activities related to Green Productivity improvement (Acharry, Boonrawd, & Chianchana,

2014). Although many countries have actively developed renewable energy technologies supported by both governments and the private sector, some barriers exist in supporting RE. These barriers, among others, include high conversion costs, limited locations, environmental impacts, and other factors pose barriers to such development (Wee et al., 2012).

In this study, the focus is the role of the supply chain in energy. Supply Chain Management (SCM) includes the coordination and management of a complex network of activities involved in delivering a finished product to the end-user or customer (Ninlawan et al., 2010). Product life cycle, especially for electronic products, has been reduced significantly in recent years due to rapid advances in technology (Osibanjo & Nnorom, 2007). All stages of a product's life cycle influence a supply chain's environmental burden, from resource extraction, to manufacturing, use and reuse, recycling, and, finally, to disposal (Zhu et al., 2007).

The "green" component of a supply chain refers to green supply chain management (GSCM), which is defined as green purchasing, green manufacturing, and reverse logistics which eliminate or minimize waste along supply chain (Hervani, Helms, & Sarkis, 2005; Cucchiella & D'Adamo, 2013). As interest in GSCM-related technologies has garnered interest from a variety of research disciplines, so too has GSCM literature grown considerably over the last decade. To date, theory and empirical research has explored the implementation and effects of such practices as eco-design, cleaner production, environmental purchasing, and green/reverse logistics, on selected performance outcomes, using financial, operational and environmental measures (Guang, Koh, Baldwin, & Cucchiella, 2012).

According to Govindan et al. (2014), GSCM not only looks at internal practices and but also external practices. For instance, environmental proactivity refers to voluntary actions beyond compliance that an industry undertakes to minimize or eliminate the negative impact of its activities and/or products on the natural environment. These include policy planning, employee training, investments in environmental technologies introduction of green products, and life cycle analysis in product design (Menguc & Ozanne, 2005). Such environmental practices also include implementing environmental management systems, enforcing environmental criteria for suppliers and distributors, obtaining environmental certifications as well as efforts to protect natural habitats and restoration measures which affected habitats (Govindan et al., 2014). Hence, the importance of GSCM in the renewable energy sector has attracted the attention of both the public and private sectors (Cucchiella & D'Adamo, 2013).

The E&E industry has indicated that the tool of "eco-efficiency" inherent in GSCM can produce desirable outcomes in economic activity that reduce undesirable environmental impacts or resource use while improving operational performance (Figge & Hahn, 2013; Hahn, Figge, Liesen, & Barkemeyer, 2010). Due to its widespread acceptance, eco-efficiency has become a popular mechanism by which to examine policy strategies and their possible outcomes (English, Castellucci, & Mynors, 2006; Wursthorn et al., 2011). Researchers in many fields have applied Eco-efficiency (EE) to improve sustainability, but a need still remains to integrate Eco-efficiency in green supply chains in order to balance the research output and to focus on both economic and environmental aspects.

In this study, the extension of green supply chain management based on the concept of eco-efficiency is examined within the bounds of a new framework. This new framework

integrates environmental and economical aspects and accounts for all aspects of sustainable development, which is one of the new trends in supply chain management (Burchart-Korol, Czaplicka-Kolarz, & Kruczek, 2012). This study conceptualises a structural model of eco-efficiency based green supply chain management and its relationship to relevant performance measures and the drivers of renewable energy initiatives. Eco-efficiency based green supply chain management is essential for business because the increased pressures for environmental sustainability and operational aspects that have everlasting impacts on the industry (Ravi, 2015). Sustainable manufacturing practices play a crucial role in promoting renewable energy development and commercialization in E&E industries.

1.3 Problem Statement

Climate change has been aggravated in recent years as CO^2 emissions continue to grow in developed and developing countries alike (IPCC, 2014). One option for transitioning towards a low-carbon society is to increase the share of renewable energy (RE) to mitigate climate change and to increase renewable energy (RE) sources (Foxon & Pearson, 2007; Jefferson, 2008). To complement these activities, increasing the overall efficiency of the energy sector is necessary (Eichhammer et al., 2013; Marques & Fuinhas, 2011; Schleich, 2009). Demands from the customers, society, non-government organizations and government agencies are vital factors in leading a company to conduct production activities concerned with environmental impacts. However, because state governments have limited financial resources, the involvement of private markets and investors is needed (Mathews et al., 2010). Included in such issues is the fact that additional costs of heat and electricity generation are incurred from most renewable energy sources (Lehr, Lutz, & Edler, 2012).

Despite successful efforts in diffusion of RE utilization, remarkable gaps between achievements and plans exist, particularly in Malaysia. Beyond the technological issues, the RE industry needs strong capital and investment, and a core role for the private sector is needed (Alireza & Ali, 2013). Today, industry performance in terms of operational and economic performance can be adversely affected, as the investment required is high for the renewable energy sources. Moreover, renewable energy is also typically more expensive than fossil-fuel based energy on a levelised-cost basis (IRENA, 2012), and the intermittent nature of some renewable sources can result in higher integration costs (Fripp, 2011). Thus utilization of renewable energy results in an increased financial burden on local distribution companies, many of which are in poor financial health to begin with (Shunglu, 2011).

A number of earlier studies, proposing sustainability-based performance evaluation (Figge et al., 2002; Sarkis, 2003), have focused extensively on the environmental impacts on operational performance as well as the importance of integrating environmental aspects into corporate strategic decision making (Shi et al., 2012). Cucchiella & D'Adamo (2013) argued that the expansion of renewable energy offered significant challenges from the supply chain perspective.

Despite the fact that sustainability aspects have been discussed widely in GSCM literature, study of the extent of GSCM practices contributing to sustainable business performance has neglected. This is because economic performance has traditionally been, and continues to be, a top management priority for manufacturers (Zhu, Sarkis, & Lai, 2013). Less evidence is also available in the literature on measurement of sustainable business performance. Other dimensions of organizational outcome, such as operational

performance, have not seen as much research or have not been (Corbett & Klassen, 2006) integrated with environmental performance and economic performance.

Therefore, the concept of green supply chain management (GSCM) has grown in importance because the practice contributes to the transition towards eco-efficiency (Govindan et al., 2014) and sustainability (Yusuf et al., 2013; Zhu et al., 2013b) and also to the future of operations management (Gunasekaran & Ngai, 2012; Diabat & Govindan, 2011). So, these are the reasons that eco-efficiency has been applied recently in the field of supply chain management such as management, operations and others to improve sustainability. The integration of eco-efficiency in GSCM encompasses not only environmental aspects but also balances and focuses both economic and environmental aspects (Govindan et al., 2014; Ravi, 2015). Despite the proliferation of research, no study addresses issues such as an eco-efficiency based green supply chain in the literature (Govindan, Sarkis, Zhu, Geng, & Jabbour, 2014). This study proposed a novel construct to fill this research gap and posits that eco-efficient based green supply chain management and sustainable business performance are related.

According to Azevedo et al. (2011), different types of green supply chain practices that are implemented can impact performance differently (Azevedo, Carvalho, & Machado, 2011). GSCM practices that involve every tier in the greening of a supply chain are often called external GSCM practices (Zhu et al., 2007a). The literature argues that, in general, the adoption of GSCM practices tends to affect not only the company's green performance (Zhu & Sarkis, 2007b; Zhu et al., 2013b) but also supply chain performance (Azevedo et al., 2011). However, with regard to external GSCM practices, such findings may not appear conclusive because both supporting (Zhu et al., 2007a; Green et al., 2012) and

contradictory results (Zallani, et al., 2012) can be found. In addition, Szwilski (2000) also has postulated that an environmental management system is an innovative environmental strategy to improve organizational operational performance. Yet, limited research has focused on other business performance outcomes such as operational performance (Murali, Saiku, & Ho, 2013).

Evaluation of the sustainability of business performance in the Electricity and Electronics industry has experienced different approaches in the assessment of its economic, social and environmental impacts (Alvarado, Palafox, & Ruiz, 2011). The stakeholders often are unable to distinguish between an organization's environmental practices and the practices of its suppliers (Rao, 2002; Sarkis, 2006). These inconclusive results raise the question of what are the actual outcomes that can be realized from the adoption of green supply chain management (Eltayeb et al., 2011). Nevertheless, the main difficulty in drawing clear conclusions from previous studies lies not only in the mixed results from different research but also the fact that scholars use different definitions/measures of environmental performance (Zeng et al., 2010). Thus, a need exists to define clearly environmental performance and how to measure it to achieve sustainable business performance.

Although many researchers have noted the important of GSCM in the scope of the RE challenges that affect the business performance, none of these studies are quantitative cross-national comparison in nature in examining the drivers that influence RE initiatives and the mediating effects of eco-efficient based GSCM towards sustainable business performance in E&E companies. This gap includes a comparison between Germany and Malaysia. Apparently, government plays the biggest role in developing RE sources through

establishing strategic plans and providing policies. However, different countries have deployed different policies and have had different experiences with RE policies; hence, presenting a benchmark for comparison between different countries is needed (Abdmouleh et al., 2015).

Inconclusive findings have coloured the GSCM literature. Several scholars (Carter, Kale, & Grimm, 2000; Rao & Holt, 2005; Zhu & Sarkis, 2004) have found that green supply chain management has a significant positive relationship with environmental and economic performance of organization. However, as Rao and Holt (2005) have remarked, research has rarely established a potential link among green supply chain management, increased competitiveness and enhanced economic performance. Previous scholars such as Vachon and Klassen (2006b) and Zhu, Sarkis, and Lai, (2007) found no significant relationship between green supply chain management and such performance outcomes. According to Zhu et al., (2012), improving their environmental management maturity before they improve green management performance through GSCM practices is desirable for companies.

This current study aims to enhance the understanding of drivers of RE initiatives that are associated with E&E-based GSCM through a comparison between E&E companies and E&E-based GSCM on sustainable business performance in Germany and Malaysia in terms of environmental, operational and economic factors. The differences between these two countries may be attributable to: (1) drivers of RE initiatives contributing to E&E-based GSCM; (2) the effect of E&E-based GSCM on Sustainable Business Practices (SPB); and (3) the mediating effects of E&E-based GSCM between RE initiatives and SBP. This study focuses on RE initiatives to provide insight about whether cross-national differences

between developed and developing countries actually exist, and whether these differences may shed light on how to promote E&E-based GSCM in the manufacturing companies especially E&E sector to increase the business performance. The belief is that RE initiatives (financial support, fiscal support, legislative support, and political support tax incentives for investment and technological support) could provide benefits and bring about successful implementation in other industries (Abdmouleh et al., 2015).

1.4 Research Objectives

There are five objectives of this study are to:

1. Examine the link between renewable energy initiatives and eco-efficient based green supply chain management;
2. Determine the extent to which renewable energy initiatives influence sustainable business performance;
3. Investigate the relationship between eco-efficient based green supply chain management and sustainable business performance;
4. Examine whether eco-efficient based green supply chain management mediates the relationship between renewable energy initiatives and sustainable business performance; and
5. Examine the differences on theoretical constructs between Malaysia and Germany in the Electrical & Electronic Industry.

1.5 Research Questions

The research questions are as follows:

1. What are the effects of RE initiatives on eco-efficient based GSCM?
2. What is the relationship between RE initiative implementation on sustainable business performance?
3. What is the relationship between eco-efficient based GSCM and sustainable business performance?
4. Does eco-efficient based GSCM mediate the relationship between RE initiatives and sustainable business performance?
5. Are there significant differences on the theoretical constructs between Malaysia and Germany in their Electrical and Electronic industries?

1.6 Definition of Key Terms

The following key terms' definitions are provided in order to share a common understanding on the concepts and create a better understanding for further discussion.

1.6.1 Renewable Energy Initiatives

A Renewable Energy Initiative is an action plan the government has developed, with the aim of reducing dependency on fossil fuel and contributing towards mitigating the effects of climate change. For example, energy policies, renewable energy programmes, renewable energy incentives and Feed-in-Tariff (FiT), and fund and financing scheme are initiatives and action plans the government can develop (Hashim & Ho, 2011).

1.6.2 Eco-efficient

Eco-efficiency is achieved by the delivery of competitively priced goods and services that satisfy human needs and bring about a better quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity (Schmidheiny, 1992).

1.6.3 Green Supply Chain Management

Green supply chain management is the set of supply chain management policies held, actions taken and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse and disposal of the industry's goods and services (Zsidisin & Siferd, 2001).

1.6.4 Eco-efficient based Green Supply Chain Management

Eco-efficiency are tools that minimize ecological damage while maximizing production efficiency and remanufacturing and that have become key assets to achieve best practices in GSCM for reducing waste and preserving the quality of product-life and natural resources (Mutingi, 2013)

1.6.5 Sustainability

Sustainability is the ability to meet current needs without hindering the ability to meet the needs of future generations in terms of economic, environmental and social challenges (Cartee & Rogers, 2008).

1.6.6 Sustainable Business Performance

Sustainable business performance is the performance of a company in all dimensions and all drivers of corporate sustainability such as employees, communities, environmental

responsibilities, transparency and accountability, and meeting tomorrow's needs with innovation accounting for all stakeholders (Schaltegger & Wagner, 2006)

1.7 Significance of Study

Renewable energy initiatives will be one of the new regimes for future growth in the energy sector. This study is among the pioneering empirical studies of renewable energy initiatives from the business performance perspective that could make notable contributions to companies, to academics and to practitioners as well as to society.

1.7.1 Theoretical Contributions

Energy has been a main contributor towards the rapid growth of Malaysia's economy. Therefore, the Malaysian government has been developing renewable energy initiatives for more than 30 years to achieve the nation's policy objectives. However, renewable energy projects have been slow to materialize. A clear understanding of the projects that must be done by both private and government sectors are needed to achieve the task. This will be a new area for the researchers to further investigate renewable energy initiatives and the opportunities associated with eco-efficient based green supply chain management implementation for companies. This study represents one of the first attempts to fill in this gap. Previously, researchers have focused more on renewable energy initiatives at the countrywide level more than at the company level. Therefore, this study will help further the research.

In addition, understanding renewable energy initiatives and eco-efficient GSCM are equally important in achieving government targets, which are to achieve better business performance in terms of environmental, operational and economic issues. Meanwhile, this

study shall also raise academic's awareness about the global warming issues and the importance of the initiatives implemented in Malaysia. In addition, the proposed framework will use organizational theories such as the Institutional Theory and the Natural Resource-based View Theory will be used to examine the variables of renewable energy initiatives and eco-efficient green supply chain management.

1.7.2 Practitioner Contributions

Over the past 10 years, the government of Malaysia has introduced many different policies, programmes, funding and schemes, and incentives to promote the implementation of RE as an alternative energy source. However, RE implementation has been slow to materialize because of the barriers to governments, researchers and stakeholders. In order to increase performance, all the drivers need to work together to enhance the goals of RE.

The E&E industry needs to utilize these RE initiatives by applying knowledge and experience in the technology rather than spending too much in trial- and-error endeavours. Operations managers should understand more about renewable energy and, in doing so, decrease communication barriers with policy makers and financiers. Malaysian banks also need to be more efficient in assisting the industry and thereby increase financial support. Companies should receive incentives and funds to implement GSCM for their business to increase bottom-line performance. For their part, companies that implement GSCM practices must ensure that both the organization and its employees accomplish the overall organizational objectives, such as cost saving, cycle-time reduction, improved environmental quality and increase value to customers as well as achieving individual goals of their employees.

Environmental collaboration with suppliers and customers leads to improved industry performance. Industry must conduct educational activities for their suppliers about environmental issues and environmental management activities (i.e., holding awareness seminars for suppliers, informing suppliers about the benefits of green practices, and bringing together suppliers in the same industry to provide them with know-how information). Industry should guide suppliers in the development of environmental programs, visiting suppliers premises to provide on-site technical assistance, and providing financial assistance to suppliers to improve their environmental performance. In fact, industries and suppliers should help each other to increase overall operational performance.

Likewise, customers should be involved in the process to improve the environmental performance. Customers should demand improved environmental performance. Industry should exchange technical information with its customers and demonstrate a willingness to learn a company's operations in order to plan and set goals for environment improvement. This implies cooperation for reducing environmental impacts associated with products flows in the supply chain. Therefore, industry should provide additional education for customers to help improve environmental performance.

Increased GSCM practices among industries, suppliers and customers should spur added economic development. This development includes increased revenues from "secondary" sales (sale of reprocessed or remanufactured products) and from offering fresh stock in place of unsold or low selling stock, goodwill earned from acting in a socially or environmentally responsible manner, cost reductions that come from the reduced cost of goods sold and lower operating expenses. All of these could enhance profitability and create better management of returned inventory that can improve asset turnover. Generally,

industries that apply initiatives from government and make their customers and suppliers more aware of the issues will develop better business performance.

Lastly, if the E&E implements RE initiatives, manufacturing costs in the form of labour, energy, materials, and other costs should be reduced; eco-efficient based-GCSM will systematically and concretely enhancing their business. Moreover, both the private and government sectors must assist the industry in achieving a long- term commitment by the government and in sharing knowledge with employees about renewable energy.

1.8 Organization of the Dissertation

This dissertation has five chapters: the introduction, literature review, research methodology, results and discussion. Background information pertinent to this study has been presented in Chapter One as well as the problem statement, research questions and objectives. The research objectives and questions are used to guide the direction of the study. Chapter Two provides insights from previous scholarly studies, which review renewable energy initiatives, the concept of eco-efficiency, green supply chain management, business performance and the variables shown in theoretical framework. Hypotheses development is at the end of the Chapter Two. Chapter Three discusses the research methodology used in this study by explaining the research design, data collection, the method of data analysis and measurement of variables to investigate the research problem. Chapter four presents the finding and analysis of the study which includes hypotheses testing. Lastly, chapter five discuses about conclusion, limitation and recommendation for the further study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will present the previous literature that has been undertaken in this study. Thus, this chapter will present the previous overview regards the renewable energy initiatives, eco-efficient based green supply chain management and sustainable business performance. There are two theories which comprised of institutional theory and natural resource based view are included supported the proposal theoretical framework. Before summary of the chapter, the theoretical framework and the hypothesis development are presented towards the end of the chapter.

2.2 Overview of Renewable Energy

Due to the fast depletion and high cost of fossil fuel, this is now a threat to sustainable growth. Attention is now focused on renewable energies as an alternative (Maulud & Saidi, 2012). Renewable energy is a free source of sustainable energy because it can produces no negative impacts during conversion process like the emission of hazardous substances (Wee, Yang, Chou, & Padian, 2012). Hence, renewable energy has been put in the limelight and researchers have increased their efforts in upgrading the efficiency of alternative power sources thus limiting the dependency on natural resources (Ahmad, Ab Kadir, & Shafie, 2011).

2.3 Overview of Renewable Energy in Germany

For decades, Germany has been a forerunner in the development and application of renewable energy sources (RES). The country's support policies for RES have received positive attention worldwide the feed-in tariff model, determined by the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz-EEG) of 2000, has been adopted by more than two thirds of EU member states. The Act determines that every kilowatt-hour generated from renewable energy receives a fixed feed-in tariff and that network operators must feed in this electricity into the grid preferentially to the electricity generated by conventional sources. Moreover, renewable energy plant operators receive a 20 year guaranteed payment for their produced electricity ((Blazejczak et al., 2014). Amendments of the EEG are being made almost every year, supported by several other policy decisions favoring renewable energy. As a result of this governmental support, renewable energy technologies continuously increased their share in the German energy mix. By 2012, renewables contributed 12% to the total energy supply and 23% to electricity supply (Sühlsen & Hisschemöller, 2014).

The growth of renewable energy in Germany has often been cited as a model success story. The success reason is the German government launched a comprehensive series of promotions for renewable energy in the early 1990s, which has since been augmented with additional legislation and policy actions to increase renewable energy use (Runci, 2005).

The reason is Government sponsorship of renewable energy was spurred initially by energy security concerns during the 1970s. In the beginning, the energy crises of 1973-

74 and 1979-80 had severe economic impacts on Germany as on most other industrialized countries. However, renewable energy technologies have deployed rapidly in Germany since 1990 largely as a result of energy policies adopted by the German government and the European Union. In addition, federal Electricity Feed Law (StrEG) was adopted in 1991 and became the most important instrument for the promotion of renewable energy in Germany during the 1990s (Runci, 2005).

Besides, the German approach has combined ongoing R&D efforts with a variety of policy instruments (taxes, standards, etc.), favorable electricity feed laws, export promotion programs, and government secured loans for renewable energy projects (Runci, 2005). These policies below (Table 2.1) have been helping Germany to attain a leading position in many aspects of renewable energy use. Besides, it shows that different plan with different policy target from 1985 to 2012.

Table 2.1
In force of renewable energy policy in Germany

Germany Plan	**Year**	**Description of the Policy**	**Policy Target**
Combined Heat and Power (CHP) Agreements with Industry	2012 – 2022 (Dec 31st)	• German government and German industrial sector and energy industry initialed an agreement concerning the improvement of energy efficiency in the industrial sector. • The objective is to raise energy efficiency by 1.3 percent per year.	Multiple renewable energy sources-CHP